

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
29 April 2004 (29.04.2004)

PCT

(10) International Publication Number
WO 2004/036217 A1

(51) International Patent Classification⁷: **G01N 33/543**,
H01L 51/20

(21) International Application Number:
PCT/EP2003/011221

(22) International Filing Date: 10 October 2003 (10.10.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
102 47 679.9 12 October 2002 (12.10.2002) DE

(71) Applicant (for all designated States except US): **FUJITSU LIMITED** [JP/JP]; 1-1, Kamikodanaka 4-chome, Naka-hara-ku, Kawasaki-shi, Kanagawa 211-8588 (JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **TORNOW, Marc**,

Uwe [DE/DE]; Tum, Walter Schottky Institut, Am Coulombwall, 85748 Garching (DE). **ABSTREITER, Gerhard** [DE/DE]; Tum, Walter Schottky Institut, Am Coulombwall, 85748 Garching (DE). **FUJITA, Shozo** [JP/JP]; Fujitsu Laboratories Limited, Atsugi 243-0197 (JP).

(74) Agents: **REICHEL, Wolfgang** et al.; Reichel und Reichel, Parkstrasse 13, 60322 Frankfurt am Main (DE).

(81) Designated States (national): GB, JP, US.

Declaration under Rule 4.17:

— as to the identity of the inventor (Rule 4.17(i)) for the following designations GB, JP

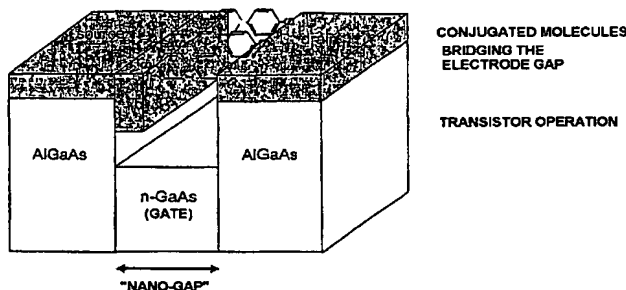
Published:

— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

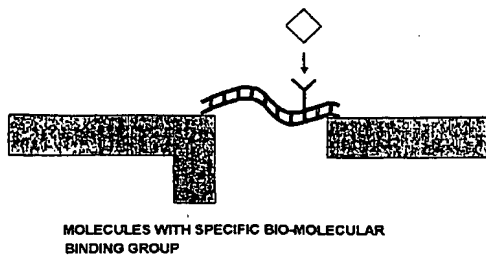
[Continued on next page]

(54) Title: SEMICONDUCTOR BASE STRUCTURE FOR MOLECULAR ELECTRONICS AND MOLECULAR ELECTRONIC-BASED BIOSENSOR DEVICES AND A METHOD FOR PRODUCING SUCH A SEMICONDUCTOR BASE STRUCTURE

A) MOLECULAR ELECTRONICS



B) BIOMOLECULAR RECOGNITION



(57) Abstract: The invention concerns a structured semiconductor surface as basis for molecular electronics or molecular electronics-based bio-sensors. The starting point is a heterostructure consisting of two undoped layers of a semiconductor material that are separated by an extremely thin (a few nm) layer of a different semiconductor material. This material stack is cleaved perpendicular to the layer planes and the middle layer is selectively etched. Source- and drain contacts for conductive organic "wires" are built by evaporation with a thin metal film. The middle conductive layer can be employed as electrostatic gate. An assembly for contacting a few up to single wires can be obtained by two sequential separations and evaporations. Possible organic wires are e.g. molecules with conjugated π -electron system, DNA-oligonucleotides or carbon nanotubes. By means of a further functionalisation with receptors for biomolecular recognition (antibodies, proteins) an employment as highly sensitive biosensor for detection, analysis and quantification of special biomolecules and their mutual interaction becomes possible (e.g. DNA-protein interaction).



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/11221

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N33/543 H01L51/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, WPI Data, EPO-Internal, COMPENDEX, INSPEC, EMBASE, MEDLINE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KRAHNE R ET AL: "FABRICATION OF NANOSCALE GAPS IN INTEGRATED CIRCUITS" APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 81, no. 4, 22 July 2002 (2002-07-22), pages 730-732, XP001130351 ISSN: 0003-6951 the whole document	1-14
P,X	KRAHNE R. ET. AL.: "Nanoparticles and Nanogaps: Controlled positioning and fabrication " PHYSICA E, vol. 17, no. 1-4, April 2003 (2003-04), pages 498-502, XP002272458 page 499-500; figures 1,2 -/-	1-14

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

10 March 2004

Date of mailing of the international search report

29/03/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Michalitsch, R

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/11221

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	POSTMA H.W.CH. ET AL.: "Carbon Nanotube Single-Electron Transistors at Room Temperature" SCIENCE MAGAZINE, vol. 293, 6 July 2001 (2001-07-06), pages 76-79, XP002272459 page 76-77	1-14
Y	SINNOTT S.B.: "Chemical functionalization of carbon nanotubes" JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY, vol. 2, no. 2, April 2002 (2002-04), pages 113-123, XP009027193 abstract page 115-116 figures 3-5	1-14